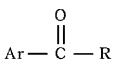
[Document Name] Description

[Title of the Invention] Electroluminescence devices

[Claim(s)]

[Claim 1] Electroluminescence devices characterized by at least one layer in said organic compound containing the compound shown with a following general formula [1] in the electroluminescence devices constituted with an anode and a cathode, and the organic compound of one layer or two or more layers ****(ed) among these.
[Chemical formula 1]



[1]

(However, Ar shows among a formula the condensed multi-ring aromatic series machine which consists of at least three or more benzene ring.) Moreover, R shows an alkyl group, an aralkyl machine, an aromatic series machine, an alkoxy group, an aryloxy group, a hydroxyl group, or a hydrogen atom.

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention has the luminous layer which consists of a luminescent substance, and relates to the electroluminescence devices which can transform electric field applied energy into light energy directly by impressing an electric field. It differs from the conventional incandescent lamp, a fluorescent lamp, or a light emitting diode in detail. It has the feature of a large area, high resolution, a thin shape, a light weight, high-speed operation, and a still more perfect solid state device, and is related with the electroluminescence devices which can be used for the erection luminescence (EL) panel which may fill an advanced demand.

[0002]

[Description of the Prior Art] The electroluminescence development of an organic material will be observed by Pope and others with an anthracene single crystal in 1963 (J. Chem.Phys.38 (1963) 2042). Helfinch and Schueider have succeeded in observation of comparatively strong injection EL by using a solution electrode system with sufficient injection efficiency in 1965 following it (Phys.Rev.Lett.14(1965) 229). Since [it], a U.S. Pat. No. 3,172,862 Description, a U.S. Pat. No. 3,173,050 Description, A U.S. Pat. No. 3,710,167 Description, J. as reported to Chem.Phys.44(1966) 2902, J.Chem.Phys.50(1969) 14364, J.Chem.Phys.58(1973) 1542, or Chem.Phys.Lett.36 (1975) 345 grade Research which formed the organic luminescence substance with the conjugate organic host substance and the conjugate organic activator with condensation benzene ring was done. Naphthalene, anthracene, phenanthrene, tetracene, pyrene, Benzopyrene, chrysene, picene, carbazole, fluorene, biphenyl, Terphenyl, triphenylene oxide, dihalo biphenyl, trans-stilbene and 1, and 4-diphenyl butane diene etc. was shown as an example of an organic host substance, and anthracene, tetracene, pentacene, etc. were mentioned as an example of an activator. However, each of these organic luminescence substances existed as a monolayer with the thickness over 1 micrometers or more, and the high electric field was required for luminescence. For this reason, research of the thin film element by a vacuum deposition method was advanced (for example, Thin Solid Films 94 (1982) 171, Polymer 24(1983) 748, Jpn.J.Appl.Phys.25(1986) L773). However, although thin-film-izing was effective in reduction of drive voltage, it did not come to obtain the high-intensity

element of the practical use level.

[0003] Tangs etc. in recent years However, (Appl.Phys.Lett.51(1987) 913 or a U.S. Pat. No. 4,356,429 Description), Two EL elements which laminated the film (a charge transport layer and luminous layer) with vacuum deposition extremely were devised between the anode and the cathode, and it realized high-intensity on low drive voltage. Also after that, this kind of laminated type organic electroluminescence device is studied actively. For example, JP,S59-194393,A, a U.S. Pat. No. 4,539,507 Description, It is indicated to JP,S59-194393,A, a U.S. Pat. No. 4,720,432 Description, JP,S63-264692,A, Appl.Phys.Lett.55(1989) 1467, JP,H3-163188,A, etc. furthermore, [Jpn.J.Appl.Phys.27(1988) L269 and L713] Even if it faces selection of the pigment of the luminous layer which the EL element of the three-tiered structure which separated the function of carrier transportation and luminescence is reported, and determines a luminescent color Restrictions of carrier transportation performance are eased, the degree of freedom of selection increases considerably, and a possibility of confining a hole and an electron (or exciton) in a central luminous layer effectively further, and aiming at improvement is also suggested. Although the vacuum deposition method is generally used for laminated type organic EL device creation It is reported that the element of remarkable brightness is obtained also by the casting method (for example, the collection 1006 (1989) of the 50th Japan Society of Applied Physics society academic lecture meeting lecture drafts and the collection 1041 (1990) of the 50th Japan Society of Applied Physics society academic lecture meeting lecture drafts). Furthermore, it is reported that the luminous efficiency in which one layer of mixing type EL element formed by the dip painting cloth method is also quite high is acquired from the solution which mixed coumarin 6 as an oxadiazole derivative and a luminous body as polyvinyl carbazole and an electronic transportation compound as a hole transportation compound (for example). The collection 1086 (1991) of the 38th Japan Society of Applied Physics relation union lecture meeting lecture drafts. As mentioned above, the latest progress in an organic electroluminescence device is remarkable, and has suggested the possibility of an extensive use.

[0004]

[Problem(s) to be Solved by the Invention] However, the history of those researches is still short and neither the material research nor the research to device-izing is yet made fully. Under the present circumstances, there is still a problem in respect of endurance, such as

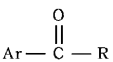
deterioration by the atmosphere gas, humidity, etc. containing optical power, aging by prolonged use, and oxygen high-intensity [further]. Furthermore, problems, such as diversification of the blue at the time of considering the application to a full KARADE spray etc., and a green and the luminous wavelength for choosing a red luminous hue precisely, are not yet solved fully, either.

[0005] Therefore, the purpose of this invention is to offer the electroluminescence devices which have very highly precise optical power in the first place. Moreover, while diversity is [second] in a luminous wavelength and assuming various luminous hues, it is in offering extremely durable electroluminescence devices. Furthermore, offering the electroluminescence-devices material which can be offered comparatively easily inexpensive has the third manufacture.

[0006]

[Means for solving problem] The above-mentioned purpose is attained by following this invention. That is, this invention is electroluminescence devices characterized by at least one layer in said organic compound containing the compound shown with a following general formula [1] in the electroluminescence devices constituted with an anode and a cathode, and the organic compound of one layer or two or more layers ****(ed) among these.

[Chemical formula 2]



[1]

(However, Ar shows among a formula the condensed multi-ring aromatic series machine which consists of at least three or more benzene ring.) Moreover, R shows an alkyl group, an aralkyl machine, an aromatic series machine, an alkoxy group, an aryloxy group, a hydroxyl group, or a hydrogen atom.

[0007]

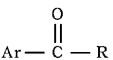
[Function] According to the electroluminescence devices of this invention which contains the layer of the above-mentioned specific organic compound as a result of inquiring wholeheartedly, in order to attain the above-mentioned purpose, this invention persons did the knowledge of being able to obtain high luminescence of luminance extremely with a low applied voltage, and excelling also in endurance extremely, and resulted in this invention. Moreover, since creation of electroluminescence devices can also be created by vacuum deposition or the casting method, it is possible to create the element of a large area easily comparatively inexpensive.

[0008]

[Best Mode of Carrying Out the Invention] Next, a desirable embodiment is mentioned and this invention is explained still in detail. Although the electroluminescence devices of this invention consist of an anode and a cathode, and an organic compound of one layer or two or more layers ****(ed) among these, they are characterized by at least one layer in an organic compound layer containing the compound shown with a following general formula [1].

[0009]

[Chemical formula 3]



[1]

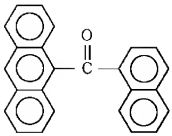
Ar in a formula shows the condensed multi-ring aromatic series machine which consists of at least three or more benzene ring, such as anthracene, pyrene, acenaphthylene, phenanthrene, full ORANSEN, bird FENIRUREN, chrysene, perylene, tetracene, pentacene, and coronene. R is C1 - C4. Aralkyl machines, such as an alkyl group, benzyl, phenethyl, and naphthyl methyl, Aryloxy groups, such as alkoxy groups, such as aromatic series machines, such as a phenyl, naphthyl, and anthryl, methoxyethoxy one, and propoxy one, phenoxy, and naphthoxy one, a hydroxyl group, or a hydrogen atom is shown. In addition, Ar and R may have a substituent respectively. As a substituent which you may have, it is C1 - C4. Aromatic series machines, such as halogen atoms, such as an alkyl group, methoxy and an alkoxy group of ethoxy **,

fluorine, chlorine, and bromine, a phenyl, and naphthyl, or a nitro group is mentioned.

[0010] The example of representation is given about the compound shown by a general formula [1] below. However, it is not limited to these compounds.

[0011]

[Chemical formula 4]



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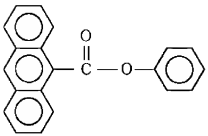

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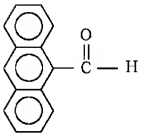

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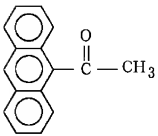

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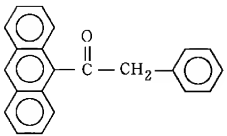

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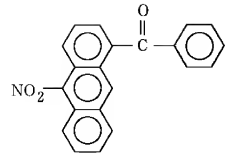
[0012]

[Chemical formula 5]



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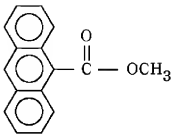

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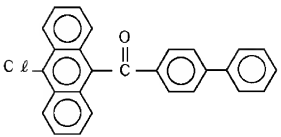

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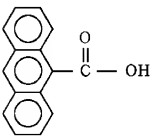

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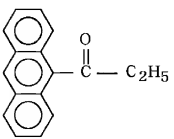

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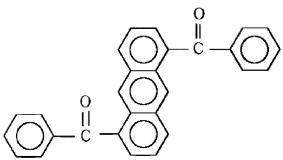
[0013]

[Chemical formula 6]



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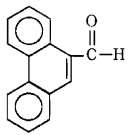

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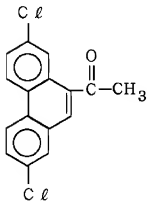

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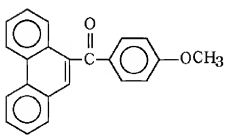

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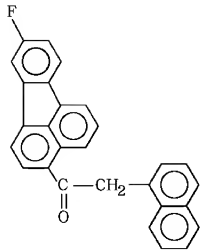
[0014]

[Chemical formula 7]



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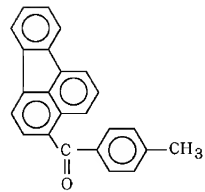

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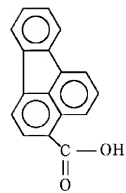

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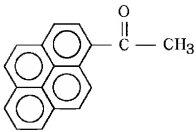
[0015]

[Chemical formula 8]



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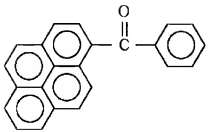

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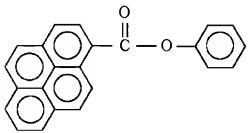

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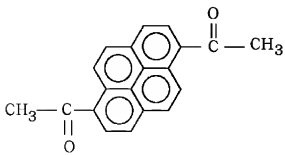

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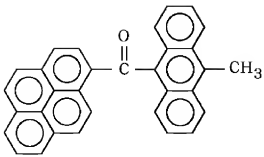
[0016]

[Chemical formula 9]



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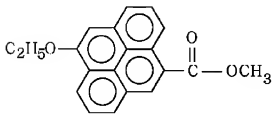

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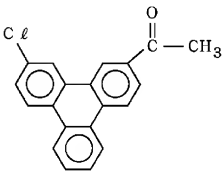

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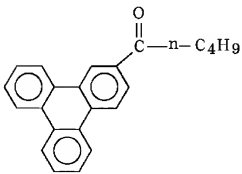

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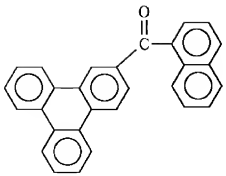
[0017]

[Chemical formula 10]



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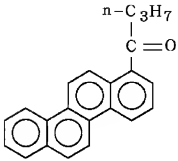

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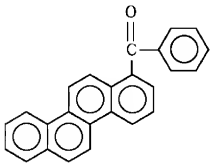

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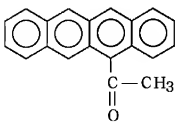

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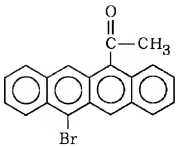
[0018]

[Chemical formula 11]



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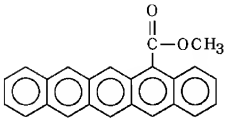

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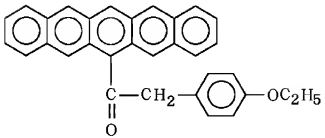

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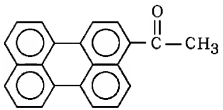

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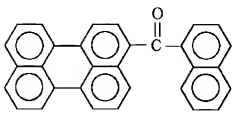

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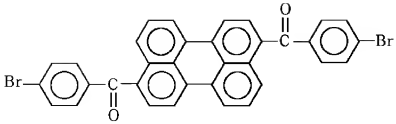

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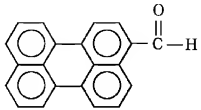

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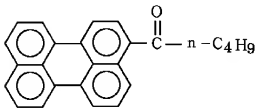

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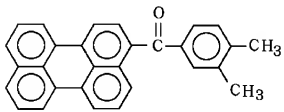

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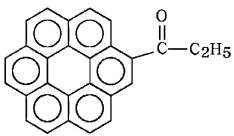
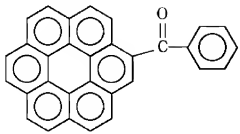


(39)

[0020]

[Chemical formula 13]



(40)

[0021] The light emitting device of this invention forms the compound shown by the above general formulas [1] between an anode and a cathode by the vacuum deposition method, the solution applying method, etc. The thickness of the organic layer is thinner than 2 micrometers, and it is desirable to thin-film-ize smaller [it is desirable and] than 0.5 micrometer.

[0022] This invention is hereafter explained still in detail over Drawings. Drawing 1 is the thing of composition of having prepared the anode, the luminous layer, and the cathode one by one on the substrate. The light emitting device used here is useful, when it is single and has hole transportation ability, electron transportation ability, and the luminescent performance by itself, or when mixing and using the compound which has each characteristics. Drawing 2 is the thing of composition of having prepared the anode, the hole transportation layer, the electron transportation layer, and the cathode one by one on the substrate. in this case -- as photogene -- hole transportability -- or it is useful, when using for each layer the material which has either of the electron transportability, or both functions and using combining a mere hole transportation substance or an electron transportation substance without luminescence.

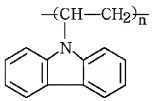
[0023] Drawing 3 is the thing of composition of having prepared an anode, the hole transportation layer, the luminous layer, the electron transportation layer, and the cathode one by one on the substrate. While this separating the function of carrier transportation and luminescence, and combining it carrier transportability, electron transportability, a compound with each luminescent characteristics, and timely, using it and the degree of freedom of

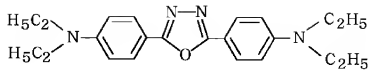
selection of material increasing extremely Since the various compounds which differ in a luminous wavelength can be used, diversification of a luminous hue is attained. Furthermore, it also becomes possible to confine a hole and an electron (or exciton) in a central luminous layer effectively, and to aim at improvement in luminous efficiency. Compared with the conventional compound, the compound used by this invention is a compound with which all were extremely excellent in the luminescent characteristic, and can be used also with one form of drawing 1, drawing 2, and drawing 3 if needed. Moreover, the compound used by this invention has either hole transportability or electron transportability and both performances according to the structure, and neither of the cases of the forms of drawing 1, drawing 2, and drawing 3 is available for it, even if two or more kinds of compounds shown by said general formula [1] are used for it if needed.

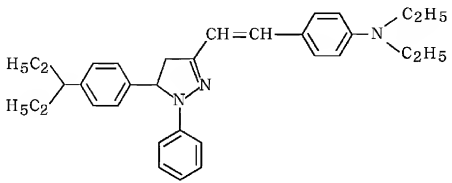
[0024] Although the compound shown by said general formula [1] as a luminous layer composition component is used in this invention The hole transportability compound currently studied in the electrophotography photo conductor field etc. if needed, the hole transportability luminous body compound known until being absorbed or an electron transportability compound, and the electron transportability luminous body compound known until now can also be used together. As these hole transportability compounds, a hole transportability luminous body compound or an electron transportability compound, and an electron transportability luminous body compound, a thing as shown below is mentioned, for example.

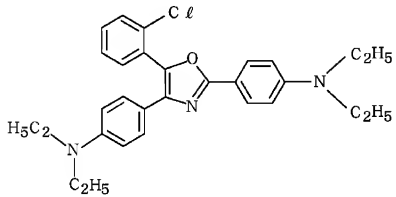
[0025] [Hole transportability compound] (hole transporter)

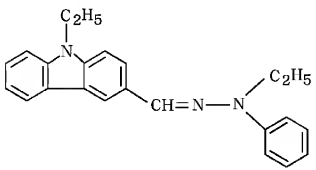
[Chemical formula 14]





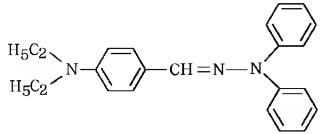


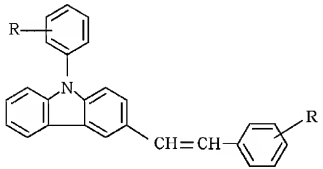


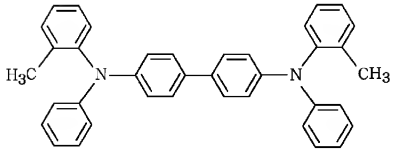


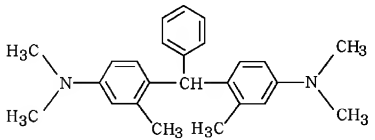
[0026]

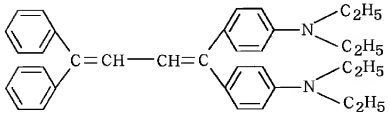
[Chemical formula 15]





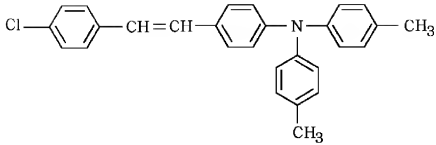


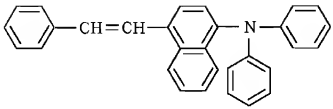


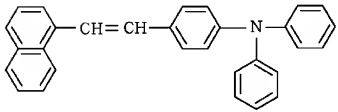


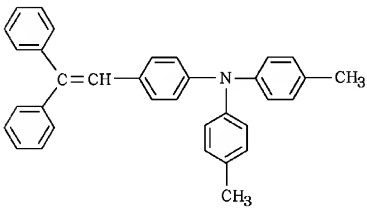
[0027] (Hole transportability luminous body)

[Chemical formula 16]


Cl
CH=CH
N
CH3
CH3

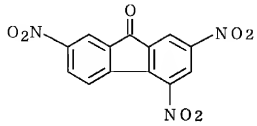

CH=CH
N

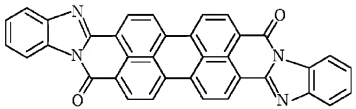

CH=CH
N

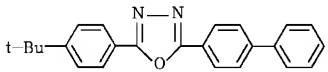

C=CH
N
CH3
CH3

[0028] [Electron transportability compound] (electron transporter)

[Chemical formula 17]

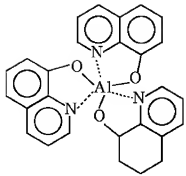


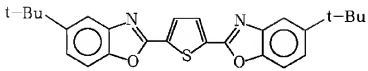


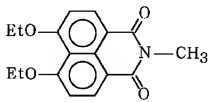


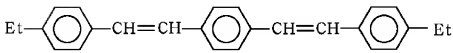
[0029] (Electron transportability luminous body)

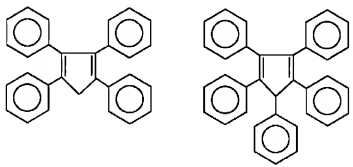
[Chemical formula 18]

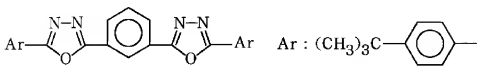












[0030] Generally the electroluminescence devices of this invention form a thin film combining vacuum deposition or suitable bending resin using the above mentioned compound. In this case, it can choose from wide range bending resin as a binder used. For example, polyvinyl carbazole resin, polycarbonate resin, polyester resin, Although polyarylate resin, butyral resin, polystyrene resin, polyvinyl acetal resin, diallyl phthalate resin, an acrylate resin, a methacrylic resin, a phenol resin, an epoxy resin, silicone resine, polysulfone resin, a urea resin, etc. are mentioned It is not limited to these. as that these are independent or copolymer polymer -- one sort -- or two or more sorts may be mixed and you may use.

[0031] What has as big a work function as an anode material as possible is good, for example, nickel, gold, platinum, palladium, selenium, rhenium, iridium, these alloys or tin oxide, tin oxide indium (ITO), and copper iodide are desirable. Moreover, conductive polymers, such as Pori (3-methylthiophene), a polyphenylene sulfide, or polypyrrole, can also be used.

[0032] On the other hand, silver and lead with a work function small as a cathode material, tin, magnesium, an aluminium, calcium, manganese, indium, chromium, or these alloys are used. Moreover, as for at least one side, it is desirable that it is what penetrates much light from 50% in the luminous wavelength field of an element among the materials used as an anode and a cathode. Moreover, glass, plastic film, etc. are used as a transparency board used by this invention.

[0033]

[Working example] Hereafter, the work example and comparative example of this invention are given, and this invention is explained still more concretely. (Work example 1) on the transparent anode of tin oxide indium (ITO) film (50nm) glass 80nm of luminous layers which consist of said illustration compound (18) carried out, and 200nm of cathodes which consist of a Mg/Ag (10/1) alloy were formed by the each sequential vacuum deposition method, and the electroluminescence devices of this invention as shown in drawing 1 were created. Thus, when the anode and cathode of the element which were created were tied with lead wire, the direct current power source was connected and the voltage of 10V was impressed, it is current density 7.5mA/cm2. Electric current flows into an element and it is 0.07mW/cm2. Photoelectrical power was checked. And when current density (7.5mA/cm2) as it is was

maintained for 24 hours, it is the last output of 0.06mW/cm2 also in 24 hours. Optical power was obtained with the applied voltage of 11.0V.

[0034] (A work example 2 - work example 5) Illustration compound described above instead of the illustration compound (18) used in the above-mentioned work example 1 The electroluminescence devices of this invention were created like the work example 1 except having used (11), (16), (29), and (37), respectively. And it is current density 7.5mA/cm2 to those obtained elements. Electric current was sent for 24 hours. The result at that time is shown in the following table 1.

[0035]

[Table 1]

実施例	例示化合物No.	初期		24時間後	
		印加電圧（V）	光出力（mW/cm^2）	印加電圧（V）	光出力（mW/cm^2）
1	(11)	11.2	0.04	12.3	0.03
2	(16)	10.8	0.06	11.8	0.06
3	(29)	8.5	0.12	9.4	0.11
4	(37)	9.6	0.10	10.1	0.09

[0036]

[Comparative Example(s)] (A comparative example 1 - comparative example 3) Illustration

compound used in the work example 1 Instead of (18), the element for a comparison was formed like the work example 1 except having used the compound (a) of the following constitutional formula, (b), and (c), respectively.

[0037]

[Chemical formula 19]

(a) (b) (c)

The anode and cathode of each element which made the appearance and were formed are tied with lead wire, a direct current power source is connected, and it is current density 7.5mA/cm2 like a work example 1. Electric current was sent for 24 hours. The result at that time is shown in the following table 2.

[0038]

[Table 2]

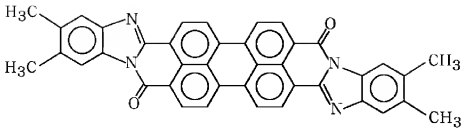
比較例	比較化合物 No.	初期		24時間後	
		印加電圧 (V)	光出力 (mW/cm^2)	印加電圧 (V)	光出力 (mW/cm^2)
1	(a)	19.1	0.001	26.1	光出力認められず
2	(b)	12.3	0.005	17.1	0.002
3	(c)	14.9	0.002	19.6	0.001

[0039] It turns out that the element of the work example of this invention is extremely excellent in optical power and endurance compared with the thing of a comparative example so that clearly from the above Table 1 and 2.

[0040] (Work example 6) on the transparent anode of tin oxide indium (ITO) film (60nm) glass said illustration compound carried out 45nm of luminous layers which consist of (39), 40nm of electron transport layers which consist of a compound (A) shown in the following, and the cathode (nm) which consists of a Mg/Ag (10/1) alloy were formed with each sequential vacuum deposition, and the element as shown in drawing 2 was created.

[0041]

[Chemical formula 20]



(A)

Thus, when the anode and cathode of the element which were created were tied with lead wire, the direct current power source was connected and the voltage of 9.0V was impressed, it is current density 5.0mA/cm2. Electric current flows into an element and it is 0.19mW/cm2. Optical power was checked. And when current density (5.0mA/cm2) as it is was maintained for 24 hours, it is last output 0.17mA/cm2 also in 24 hours. Optical power was obtained with the applied voltage which is 8.4V.

[0042] (A work example 7 - work example 10) Illustration compound used in the work example 6 Instead of (39), it is said illustration compound. The electroluminescence devices of this invention were created like the work example 1 except having used (19), (26), (28), and (34), respectively. And to those obtained elements, it is current density 5.0mA/cm2. Electric current was sent. The result at that time is shown in the following table 3.

[0043]

[Table 3]

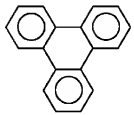
実施例	例示化合物No.	印加電圧（V）	光出力(mW/cm^2)
7	（19）	8.2	0.18
8	（26）	7.9	0.21
9	（28）	8.7	0.16
10	（34）	9.2	0.17

[0044] (A comparative example 4 - comparative example 6) The electroluminescence devices for a comparison were created like the work example 1 except having used the compound (d) shown by the following formula, (e), and (f) instead of the illustration compound (39) used in the work example 6, respectively. And it is the current density of 5.0mA/cm2 like [those obtained elements] a work example 6. Electric current was sent. The result at that time is shown in the following table 4.

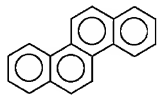
[0045]

[Chemical formula 21]

(d)



(e)



(f)

[0046]

[Table 4]

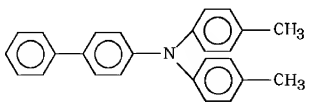
比較例	比較化合物No.	印加電圧（V）	光出力（mW/cm^2）
4	(d)	14.1	0.001
5	(e)	16.2	0.001
6	(f)	18.1	光出力認められず

It turns out that the electroluminescence devices of this invention are excellent in optical power compared with the electroluminescence devices of a comparative example so that clearly from Table 3 and 4.

[0047] 60nm of anodes which consist of gold on a glass substrate, 60nm of hole transportation layers which consist of a compound (B) shown in the following, (Work example 11) 60nm of luminous layers which consist of said illustration compound (25) carried out, and 150nm of cathodes which consist of an aluminium were formed with each sequential vacuum deposition, and the electroluminescence devices of this invention as shown in drawing 2 were created.

[0048]

[Chemical formula 22]



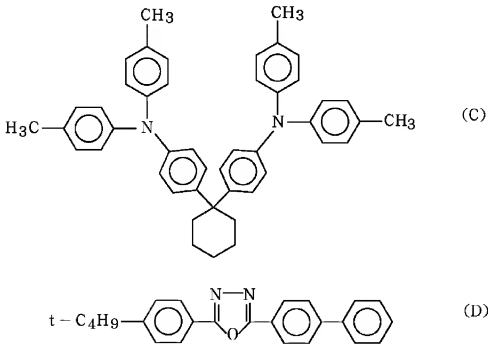
(B)

Thus, when the anode and cathode of the element which were created were tied with lead wire, the direct current power source was connected and the voltage of 8.5V was impressed, it is current density 6.5mA/cm2. Electric current flows into an element and it is 0.11mW/cm2. Optical power was checked.

[0049] (Work example 12) on the transparent anode of tin oxide indium (ITO) film (60nm) glass 65nm of luminous layers as for which 45nm of hole transportation layers which consist of a compound (C) shown below consist of the above mentioned illustration compound (31), 50nm of electron transport layers which consist of a compound (D) shown below, and 150nm of cathodes which consist of a Mg/Ag (10/1) alloy were formed with vacuum deposition one by one, and the electroluminescence devices of this invention as shown in drawing 3 were created.

[0050]

[Chemical formula 23]



Thus, when the anode and cathode of the element which were created were tied with lead wire, the direct current power source was connected and the voltage of 8.0V was impressed, it is current density 6.0mA/cm2. Electric current flows into an element and it is 0.18mW/cm2. Optical power was checked.

[0051] (A work example 13 - work example 16) Illustration compound used in the work

example 12 Instead of (31), it is said illustration compound. The electroluminescence devices of this invention were created like the work example 12 except having used (6), (21), (33), and (36), respectively. And to those obtained elements, it is current density 6.0mA/cm2. Electric current was sent. The result at that time is shown in the following table 5.

[0052]

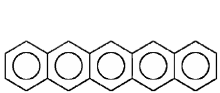
[Table 5]

実施例	例示化合物No.	印加電圧(V)	光出力(mW/cm^2)
13	(6)	10.5	0.09
14	(21)	8.2	0.17
15	(33)	7.8	0.20
16	(36)	8.1	0.19

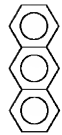
[0053] (Comparative examples 7-9) Illustration compound used in the work example 12 The element was created like the work example except having used the compound (g) shown below, (h), and (i) instead of (31), respectively. And it is the current density of 6.0mA/cm2 like [those obtained elements] a work example 12. Electric current was sent. The result at that time is shown in the following table 6.

[0054]

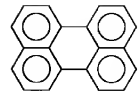
[Chemical formula 24]



(g)



(h)



(i)

[0055]

[Table 6]

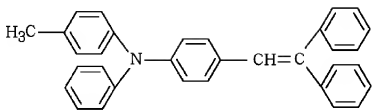
比較例	比較化合物Ｎｏ．	印加電圧（Ｖ）	光出力（mW/cm^2）
7	（ｇ）	１６．８	０．００３
8	（ｈ）	２１．５	光出力認められず
9	（ｉ）	１７．２	０．００２

From Table 5 and 6, it turns out that the electroluminescence devices of this invention are extremely excellent in optical power compared with the element of a comparative example so that clearly.

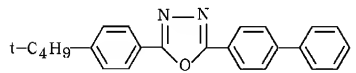
[0056] (Work example 17) Illustration compound (20) 2g, hole transportation (compound E) 1g shown with the following constitutional formula, electron transportation (compound F) 1g, and 3g of polycarbonate resin (weight average molecular weight 35,000) were dissolved in tetrahydrofuran 280ml, and coating liquid was prepared. This coating liquid was applied by my YABA on the transparent anode of tin oxide indium (ITO) film (50nm) glass, and the 450nm layer was formed. And on it, the vacuum deposition of the aluminium was carried out, the anode was formed, and the element was created.

[0057]

[Chemical formula 25]



(E)



(F)

Thus, when the anode and cathode of the element which were created were tied with lead wire, the direct current power source was connected and the voltage of 13.0V was impressed, it is current density 4.2mA/cm2. Electric current flows into an element and it is 0.02mW/cm2. Optical power was checked.

[0058]

[Effect of the Invention] The electroluminescence devices of this invention can obtain high luminescence of luminance extremely with a low applied voltage to the appearance explained above, and it excels also in endurance extremely. Moreover, it is possible to be also able to create creation of electroluminescence devices by vacuum deposition or the casting method, and it to create the element of a large area easily comparatively inexpensive.

[Brief Description of the Drawings]

[Drawing 1] Drawing 1 is the typical sectional view of the electroluminescence devices in connection with this invention.

[Drawing 2] Drawing 2 is the typical sectional view of the electroluminescence devices in connection with this invention.

[Drawing 3] Drawing 3 is the typical sectional view of the electroluminescence devices in connection with this invention.

[Translation done.]